**DIELECTRIC SPECTROSCOPY FOR *IN SITU* DETECTION OF MICROBIAL LIFE FORMS ON MARS.** D. Warmflash[1,2], J. H. Miller, Jr.[1], D.S. McKay[2], G.E. Fox[1], and D. Nawarathna[1]; [1]University of Houston; [2]NASA Johnson Space Center, Houston, TX, email dwarmfla@ems.jsc.nasa.gov

A challenge to astrobiological investigation of Mars is to develop *in situ* instruments capable of distinguishing environmental samples or extracts containing life forms from those that do not. At the same time, the life-detection technology must not be geocentric; that is it must not be targeted to characteristics that, although specific for life, may be limited to those life forms native to Earth. Because life throughout the Cosmos, regardless of its biochemistry and/or its genetic material, must utilize a variety of charged macromolecules, we are investigating the use of dielectric spectroscopy (DS) as a life-detection tool.

In an initial study, as environmental samples, we used common soil and JSC Mars-1, a volcanic ash from Hawaii, developed for use as a Mars regolith simulant. Biologically active, JSC Mars-1 contains microorganisms and biomolecules equivalent to $10^6$–$10^7$ cells/gram, less than common soils (which can contain quantities of up to $10^9$ cells/gram). Portions of each environmental sample were left untreated, while other portions were sterilized: autoclaved for 60 minutes at 121˚ C, at 2 atm, then heated in an oven at 220˚ for 3 hours followed by exposure to ultraviolet light for 16 hours. Water extractions were then performed on sterilized and untreated soil and JSC Mars-1 samples. Extracts of untreated soil and JSC Mars-1 yielded multiple microbial strains when incubated on Luria Broth (LB) agar for 24 hours at three temperatures: 23˚ C, 30˚ C, and 37˚ C. Extracts of sterilized soil and JSC Mars-1 showed no growth at any of these temperatures, indicating that the sterilization protocol had indeed destroyed all living forms within the environmental samples.

When DS was conducted on extracts, dielectric constant and conductivity were found to be higher for sterilized samples as compared with untreated samples. We hypothesize that the sterilization protocol results in increased dielectric constant and conductivity due to lysis of cells and consequent release of charged molecules. However, the values obtained for unsterilized samples may be due not only to the presence of charged molecules but also to membrane potentials of living cells. Samples containing living cells may thus be distinguishable from those containing only macromolecules by performing DS at variable temperatures. Thus at two temperatures, 4˚ C and 37˚, we tested a suspension of the bacterium, *E. coli*, as well as three examples of large, charged biomolecules: deoxyribonucleic acid (DNA), hemoglobin (Hb), and bovine serum albumin (BSA). At 10 Hz, dielectric constant for *E. coli* suspension increased by 70% at 37˚ as compared to 4˚, while dielectric constants for DNA, Hb, and BSA increased by 28% 17%, and 49% respectively. Furthermore, DNA, Hb, and BSA used in this preliminary study were not sterile, so it is possible that the dielectric differences measured at the two temperatures for these macromolecules –although lower than the difference observed for *E. coli* – are due in part to bacterial contamination and this will be investigated.

DS may be applicable to *in situ* astrobiology studies on the surface of Mars and the variable temperature method will be tested on soil and JSC Mars-1. Additionally, other manipulations, such as treating samples with stereoisomers of simple nutrients (ie. small amino acids or sugars) prior to DS, may also help in distinguishing biological from sterile samples. Finally, we have developed nonlinear dielectric response techniques, which will also be tested for their ability to differentiate living from sterile material.